Determinants of Healthy Food Consumption and the Effect of Saudi Food Related Policies on the Adult Saudi Population, a National Descriptive Assessment 2019

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Abstract

Saudi Arabia (SA) is a country with an advanced nutritional transition, so this study aims to measure the prevalence of healthy food consumption and its context, and to study the effect of Saudi Arabia's policies on the pattern of food consumption among inhabitants in SA. Through an online self-administered and validated questionnaire, the cross-sectional study recruited 590 randomly chosen adult Saudis who were stratified to represent the 20 health regions in KSA. Ethical approval was obtained for this work. The relevant tests were used to code and analyze the collected data. Of the 590 participants, 50.2% were males, with a mean ± SD age of 35.6±10.52 year.43.2% of the participants did not meet the Ministry of Health recommendation in any food group, while only 1.53% consumed the recommended amounts of all food groups. 47.8% of the participants did not perform any physical activity. 34.7% of participants prefer healthy food, 18.8% prefer unhealthy food, and 46.5% prefer both. Most Saudis do not comply with the national dietary guidelines' recommendations, they are physically inactive, and they use social media in a way that affects their food choices.

Introduction

The global and Middle East nutritional transition, including the Kingdom of Saudi Arabia (KSA), has raised the burden of chronic and non-communicable diseases (NCDs). From 1961 until 2007, the Food and Agriculture Organization of the United Nations (FAO) revealed an increased food intake in KSA.[1]

KSA is the world's 15th most obese country, with an overall obesity rate of 33.7%. In 2016, the national Saudi survey showed that the prevalence of obesity was 28.7%, which is more prevalent in women. Worldwide, the World Health Organization (WHO) reported 500 million overweight and obese adults, and 600 million adults in 2014, and predicted that the majority of adults will be obese or overweight by 2030.[2]

Many negative effects have developed, especially in high, certain-low, and middle-income countries, where childhood obesity is considered a pandemic. They are more likely to be obese adults and directly reflect on developing chronic diseases. Obesity raises the risk of NCDs, which will be the leading cause of death in the Kingdom of Saudi Arabia until 2021.[2,3,4]

Eating healthy food (HF) is defined as the consumption of the right food quantities from all food groups. HF eating habits develop early in life, beginning with breastfeeding,[6,7] and are necessary for normal healthy growth, controlling body weight, maintaining body function and nourishment, lowering levels of low-density cholesterol, preventing constipation and colon cancers, and reducing the development of NCDs.[8,20] Unhealthy food (UHF) is also called fast food (FF) or junk food (JF), defined as high-calorie or calorie-rich food products that are designed for ready availability, use, or consumption with little consideration given to quality. UHF is available in different types[18]

A popular trend of unhealthy eating habits includes skipping breakfast meals in favor of eating more food rich in sugar and fat, instead of fruits and vegetables, which leads to an energy disproportion between calories consumed and calories expended, in addition to low physical activity.[3] That leads to preventable conditions such as malnutrition (as anemia and cachexia) and NCDs (such as diabetes,

obesity, CVDs), vitamin deficiency, and many types of cancer) by adopting a healthy eating pattern.[5] The pattern of food intake is not constant and is influenced by many factors, including socio-economics, food cost, food taste, individuals' preferences, cultural traditions, environmental factors, time constraints, personal perception, convenience, and accessibility.

In 2012, the Saudi Ministry of Health (SMOH) designed HF Palm to place food groups in the palm truck and leaves according to the recommended amounts and size of the food groups for the Saudi population according to their needs, considering many variables. For example, a hot climate needs more water consumption, a lack of sunlight exposure needs more vitamin D-containing food to compensate for vitamin D deficiency.[8] SMOH has published dietary guidelines for Saudis that adopt a healthy eating routine (pattern and amount) with regular physical activity to improve the Saudi population's lifestyle and promote HF eating.[8,9,10,11] SMOH recommends that plates contain 30% vegetables, 20% fruits, 25% cereals, 25% proteins, and one serving of milk or milk products. Half of the plate should contain non-starchy fruits and vegetables (low in calories and rich in fiber), a quarter of whole grains, and a quarter of proteins to ensure a healthy eating pattern, which is not difficult to achieve.[8,9]

KSA's Ministry of Education (MOE) developed and maintained the "Regulations of Health Conditions for School Canteens" in 2004 to improve the healthy school environment and food choices in schools, with a new update of policies in 2013. The ministry was effective in 1) the list of banned foods includes confectioneries, chocolates, chips, all meat products, and fried foods. 2) Abolition of sugar-sweetened beverages such as soda and energy drinks in public schools; and 3) increased availability and accessibility of nutritious food.4) Confirmed a limited presence of a breakfast meal containing HF options by the schools.[3]

Saudi Vision 2030 emphasizes the importance of attention to chronic diseases because of the cost and ineffectiveness of treatment. SMOH established a calorie guide and a food calorie calculator on its website.[9] At the end of 2018, the Saudi Food

and Drug Authority stated a supportive food policy for the realization of the Saudi vision (written in the methodology section).[28]

For several decades, the Kingdom of Saudi Arabia has been regarded as a country in advanced nutritional transition, undergoing epidemiological and demographic transition.[13] This can be reduced through the consumption of nutritious foods and a routine of increased physical activity.[25] Food cost, taste, and the time needed to prepare healthy food were the most common impediments that prevented people from maintaining a healthy diet.[20,27]

Planning for improvement in overall community health should include access to affordable and healthy food. Planners, local government officials, food retailers, and food policy councils are among those who can help ensure a healthy food environment in their community.[27]

Aim and Objectives
So that this study was conducted among adult Saudis in SA and aimed, 1) to measure the prevalence of HF consumption as recommended by MOH dietary guidelines. 2) to study the determinants (context and factors) affecting HF eating of sex and age. 3) to study the effect of SFDA food-related policies, and the use of MOH applications. This study provides evidence-based assessment to aid policymakers and health sectors for better management and preventive measurements.

Methods
Study Design and Setting
An online cross-sectional study was conducted in all the 20 health regions of Saudi Arabia in July and August 2019.

Study Population and Selection Criteria
Any Saudi citizen who meets the selection criteria and is at least 18 years old, aged between 18- and ≤ 65 years old.14,531,201,[29] non-illiterate (94.8%) Internet users (91%),30 without any mental and/or psychological disorders and agreed to participate.

Sampling Methods, Size, and Technique
stratified simple random. The sample size was calculated using the EPI info website, with a total population of 15,531,201 after excluding illiterates

of around 3 million, making the target population of 12,212,742. The prevalence of internet users was 91%.[30] So the total population will be 11,125,581. The prevalence of consuming > 40% of total caloric intake from a nutritious diet is 34.3 %.[31] A precision of 0.5% at a 95% confidence level and the power of the study was 80%. The sample size was stratified to the 20 health regions in Saudi Arabia and weighted based on the total population number, e.g., Riyadh 22.3%, Jeddah 8.9%, Eastern region 8%, Makkah 7.1%, Al Madinah Al Munawara 5.8%, Al-Taif 5.4%, Asser 4.5%, Jizan 4.5%, Al-Qassem 3.6%, Hafr Al Batten 3.6%, and 2.7% from the will be doubled to be 590.

Data Collection Tool
To collect data, pre-tested, pre-coded, well-structured, self-administered, and validated by three experts' questionnaires were used. The questionnaire was designed in Arabic on the Google forms, and composed of five main sections: (Index II)

Section 1
describes the characteristics and demographic data of the study population.

Section 2
collect data on the frequency of healthy food consumption and consumption of different food groups based on MOH guidelines[8] as (never eat it = 1, less than recommended = 2, as recommended = 3, more than recommended = 4).

Section 3
Collect data regarding physical activity

- Sedentary (watching TV, etc.)
- Light PA is PA (less than 2:30 hours) per week or 5000 to less than 7500 steps daily.
- Moderate PA means PA from 2:30 to 5:00 hours per week or from 7500 to 10,000 steps daily.
- Vigorous PA means (> 5 hours) a week of PA or (> 10,000 steps) daily.

Section 4
describes the context of HF, and UHF consumption (times, weekly cost, and reasons) and the food types' preferences, reasons, and the mean spending SR.

Eating practices score, a score from zero to four is given for each practice.

- HF practices through 5 questions "Zero" (never) means the worst practice in healthy practices. Four (> 5 times per week) is the best practice in healthy practices.
- UHF practices through 6 questions Zero (never) means the best practice in unhealthy practices. Four (> 5 times per week) is the worst practice in unhealthy practices. At the end, each participant is given a total score for unhealthy practices out of 24.

Section 5
collects data on the use and types of mobile phone applications and social media networking.

Section 6
to assess knowledge of food-related policies and use of the Ministry of Health's calorie guide. Knowledge and use of the MOH calorie calculator. The impact of mandatory calorie labeling on food choices, ready-to-eat food spending, and weight loss is yet to be seen.

A policy has emerged from the Saudi Food and Drug Authority (SFDA). The policy states the following.[23]

Calories must be consumed.

- The same font and color are displayed next to every food item on the menu.
- Written in various food list formats,
- Demonstrated for one plate (example: pizza – 1600 calories), and may be demonstrated as individual units, so the calories must be written as (example: pizza – 200 calories per piece, "8 pieces".
- Written individually for every food element in outlets as an ingredient in an open buffet.
- Individually in the side dishes of the menu, such as ice cream.
- demonstrated clearly for specially cooked foods, such as: grilled chicken, fried chicken,

Food agencies must write, "Adults need about 2000 calories daily on average, and it may differ according to individual needs" in the main menu and external menu.

Food agencies must write "Additional food information is available when needed" on the main menu and any external menu of any type (wooden, electronic, etc.).

Statistical Analysis
data was analyzed by using the Statistical Package for Social Sciences (SPSS) (version 23) and Microsoft Excel was used to develop the graphs. The considered level of significance is (P-value. 05), 80% of the power of the study, and 95% of the Confidence Interval. For quantitative data, mean, median, standard deviation, and range are used to summarize, and the Mann Whitney U test is used for analysis. Number frequency (F) and percentage were used for qualitative data summarization and the Chi-square test (X2) for analysis. To study the association between two continuous variables (age and scores), the person correlation coefficient (r) was used.

Results
From all the twenty health regions of SA, 590 Adult Saudis were included in this study. 85.4% of the participants living inside cities and 14.6% living outside the cities. 296(50.2%) of them were males while 294(49.8%) were females with mean age (35.6 ± 10.52). 66.3% of the participant's work. 35.8% work in the education field, 28.6% work in the medical field, and 35.6% work in other fields Most of the participants were married 67.5%, were 71% university and above. 57.5 % with about 50 % enough monthly income. 61.5% non-smokers, 45.3% stated that very good health status, and 25.4% of them reported having a chronic disease (mainly 32.7% have hypertension, then 26.7% have diabetes). [Table 1]

The participants reported different patterns of consumption of all food groups. 62.0% consume less than two portions per day, while only 26.8% follow the MOH guidelines and eat 2-3 portions of meat daily. Milk and dairy products are consumed in less than 2 portions per day by 68.8% of the population, while only 19.7% consume the recommended portions (2-4 portions per day). Furthermore, the majority (68.0%) consumes fruits in less than two portions per day, while 17.5% consume 4–6 portions per day as recommended [Table 2].

Table 1: Demographic data of the participants.

Socio demographic characteristics	N (%)
Sex	
Male	296(50.2)
Female	294(49.8)
Age(y)	
Mean+_ SD	35.6+_10.5
Age group	
16-<40	445(75.4)
40-<65	143(24.2)
65 or more	2(0.3)
Level of education	
Primary	28(4.7)
Intermediate	33(5.6)
Secondary	110(18.6)
University and above	419(71.0)
Marital status	
single	154(26.1)
Married	398(67.5)
Divorced	27(4.6)
Widow	11(1.9)
Working status	
Working	391(66.3)
Not working	156(26.4)
Retired	43(7.3)
Place of living	
Inside the city	504(85.4)
Outside the city	86(14.6)

Vegetables were the most common food group that participants showed consumption less than recommended, 75.4% consumed vegetables less than 3-5 portions/day and only 13.7% followed the recommendations. 71.5% of participants consumed less than 6-11 portions of cereals and bread per day, while only 21.9% consumed the recommended portions [Table 2].

There was no significant difference between males and females in consumption of food groups except for meat and legumes, where the males significantly consumed meat and legumes as recommended more than the females (P = 0.00). 43.22% of the participants did not meet the MOH recommendation in any food group, while only 1.53% consumed the recommended amounts of all food groups, with no significant difference between males and females. 46.9% of the study population drinks less than 6 cups of water per day, while 27.1 drink 6 cups daily as recommended by MOH, with no significant difference between males and females (Table 2).

47.8% of the participants do not perform any PA except daily activities only, while only 5.8% perform vigorous physical activity. There is a significant difference between males and females, where females are higher in never performing PA and performing moderate PA than males. (Table 2)

Table 2: Daily food consumption and physical activity, and its relation with the sex

Food group	N	%	Male N	Male %	Female N	Female %	P-value
Meat and legumes							
Never eat it	13	2.2	4	30.8	9	69.2	0.00**
Less than 2 portions	366	62.0	157	42.9	209	57.1	
2-3 portions*	158	26.8	96	60.8	62	39.2	
More than 3 portions	53	9.0	39	73.6	14	26.4	
Milk and dairy products							
Never eat it	50	8.5	32	64.0	18	36.0	0.15
Less than 2 portions	406	68.8	197	48.5	209	51.5	
2-4 portions*	116	19.7	60	51.7	56	48.3	
More than 4 portions	18	3.1	7	38.9	11	61.1	
Fruits							
Never eat it	74	12.5	34	45.9	40	54.1	0.06

Less than 2 portions	401	68.0	214	53.4	187	46.6	
2-4 portions*	103	17.5	41	39.8	62	60.2	
More than 4 portions	12	2.0	7	58.3	5	41.7	
Vegetables							
Never eat it	54	9.2	27	50.0	27	50.0	0.92
Less than 3 portions	445	75.4	223	50.1	222	49.9	
3-5 portions*	81	13.7	42	51.9	39	48.1	
More than 5 portions	10	1.7	4	40.0	6	60.0	
Cereals and bread							
Never eat it	10	1.7	5	50.0	5	50.0	0.29
Less than 6 portions	422	71.5	202	47.9	220	52.1	
6-11 portions*	129	21.9	71	55.0	58	45.0	
More than 11 portions	29	4.9	18	62.1	11	37.9	
Recommended Food groups consumption score							
Score							
0	255	43.2	127	49.8	128	50.2	0.58
1	173	29.3	79	45.7	94	54.3	
2	98	16.6	53	54.1	45	45.9	
3	47	8.0	28	59.6	19	40.4	
4	8	1.4	4	50.0	4	50.0	
5	9	1.5	5	55.6	4	44.4	
Water consumption							
Less than 6 cups	277	46.9	132	47.7	145	52.3	0.51
6 cups*	160	27.1	83	51.9	77	48.1	
More than 6 cups	153	25.9	81	52.9	72	47.1	
Physical activity (PA)							
Never	282	47.8	123	43.6	159	56.4	0.01**
Sedentary	120	20.3	69	57.5	51	42.5	
Light PA	77	13.1	43	55.8	34	44.2	
Moderate PA	77	13.1	37	48.1	40	51.9	
Vigorous PA	34	5.8	24	70.6	10	29.4	

* Number of portions recommended by Saudi MOH dietary guidelines
** Significant P- value

The mean total healthy eating practices score is 12.87 4.04 without a significant difference between males and females. The total unhealthy eating practices score median is 14 with a range of 0-24 without a significant difference between males and females (Table 3). The details are in Appendix I.

The study population spent more money on unhealthy food than healthy food. The median amount spent on healthy food per week is 50 Saudi Riyals (SR), with a range of 0–2000 SR. While the median weekly expenditure on unhealthy food is 95 SR, with a range of 0–2000 SR. There is no significant difference in spending on healthy and unhealthy foods for sex [Table 3].

44.4% of participants think they are consuming salt within the recommended amount (5 mg/day). 23.7% of them think they consume less than 5 mg of salt per day. 23.7% think they consume a higher amount of salt than recommended. Participants reported using different types of fat. They use one or multiple types. Most of them (68%) use vegetable oil, followed by butter (30.8%), ghee (27.5%), and hydrogenated oils (16.3%) [Table 4].

Table 3: Mean of total healthy eating practices score and median of unhealthy eating practices score, and Median and range of spending on healthy and unhealthy food per week in Saudi Riyals

Mean of total healthy practices score **							
Mean	SD*	SE*	Sex	Mean	SD*	SE*	P-value
12.87	4.04	0.17	Male	12.99	4.15	0.24	0.47
			Female	12.75	3.94	0.23	

Median and range of total unhealthy practices score **						
Median	Range	Sex	Median		Range	P-value
14	0-24	Male	14		0-24	0.18
		Female	13		0-24	

Spending on healthy food						
Median	Range	Sex	Median		Range	P-value
50	0 - 2000	Male	45		0 - 2000	0.16
		Female	50		0 - 1400	

Spending on unhealthy food						
95	0 - 2000	Male	100		0 - 2000	0.32
		Female	90		0 - 1000	

* SD: Standard deviation, SE: Standard error of the mean

** For more details please refer to index 2

Participants were asked about their food preferences. 34.7% of them said they prefer healthy food, 18.8% prefer unhealthy food, and almost half of them (46.45%) prefer both. Individuals who prefer healthy food have a single or multiple reasons for their preference. 50.3% of them prefer healthy food to maintain their weight, 29.5% said they are used to eating healthy food as a habit and a lifestyle, and 24.4% eat healthy food because they are following a diet. [Table 4].

Table 4: The salt and butter consumption, and the main reasons for food preferences

The participants' believe about their salt consumption	N (%)
Less than recommended	140(23.7)
As recommended	262(44.4)
More than recommended	107 (18.1)
Don't care	11(2.0)
Don't know	69(11.7)
The types of fat used by participants	
Butter	181(30.8)
Ghee	162(27.5)

Hydrogenated oil	401(68.0)
Not sure	62(10.5)
Not interested	18(3.1)
The main reasons for healthy food preferences	
Maintain weight	296(50.3)
Life style	174(29.5)
Following a diet	144(24.4)
Having chronic diseases	108(18.3)
Other causes	83(14.0)
The main reasons for unhealthy food preferences	
Good taste	293(49.7)
Fast preparation	185(31.5)
Eating with friends	149(25.3)
Cheaper prices	142(24.2)
Long working hours	125(21.2)
Cannot cook	40(6.8)
Unsupported work environment	38(6.4)
Being a foreigner	33(5.6)
Other causes	70(12.0)

The main reason for UHF preferences was (49.7%) because they tasted better than healthy food. by faster preparation time (31.5%), eating with friends (25.3%), and cheaper prices (24.2%) [Table 5]

The statistical correlation between age and HF practice score showed a positive correlation.

As age increases, the participants tend to have higher healthy eating practices scores. In addition, the correlation between age and spending on healthy food showed a positive correlation. As people age, spending on healthy food increases (Table 5).

Table 5: Correlation between age and recommended food consumption score, healthy and unhealthy eating practices score, and spending on healthy and unhealthy food

Variable	r	P-Value
Age		
Healthy eating practices score	0.13	0.00*
Unhealthy eating practices score	- 0.22	0.00*
Recommended food groups consumption score	- 0.01	0.81
Spending on healthy food	0.10	0.02*
Spending on unhealthy food	- 0.05	0.26

* Significant P- value

53.1% of the study population are using mobile phone applications that can affect their food choices. The majority (43.1%) of applications are for food delivery. 59.2% are following social media accounts that are related to food and physical activity. The most popular type of social media followed by the participants is social media accounts of celebrities (28.6%). Females significantly use mobile phone applications and follow social media accounts that can affect their food choices more than males (Table 6).

**Table 6: Uses and types of mobile phone applications and social media
that may affect food choices**

	N	%	Male N	Male %	Female N	Female %	P value
Use applications that may affect food choices							
Yes	313	53.1	143	48.3	170	57.8	0.02*
No	277	46.9	153	51.7	124	42.2	
Types of used applications							
Calories calculator apps	24	4.1	8	2.7	16	5.4	0.03*
Food delivery apps	254	43.1	118	39.9	136	46.3	
Sports apps	53	9.0	22	7.4	31	10.5	
Other	58	9.8	33	11.1	25	8.5	
Does not use any application	201	34.1	115	38.9	86	29.3	
Following social media accounts that may affect food choices							
Yes	349	59.2	156	52.7	193	65.6	0.00*
No	241	40.8	140	47.3	101	34.4	
Types of followed accounts							
Health accounts	50	8.5	16	5.4	34	11.6	0.00*
Cooking accounts	60	10.2	20	6.8	40	13.6	
Food evaluation accounts	18	3.1	7	2.4	11	3.7	
Restaurants accounts	15	2.5	9	3.0	6	2.0	
Social media celebrities accounts	169	28.6	87	29.4	82	27.9	
Sports accounts	40	6.8	18	6.1	22	7.5	
Other	44	7.5	26	8.8	18	6.1	
Nothing	194	32.9	113	38.2	81	27.6	

* Significant P- value

52.9% of the participants have heard of the obligatory calorie display policy. 34.1% know about school canteens free from unhealthy food policies. In addition, 20.7% know that Saudi Arabia should be free from hydrogenated oils by 2020.37.1% of the study population know about the MOH calorie guide and only 14.7% of them use it. 30.2% of the participants know about the MOH calorie calculator and only 11.4% of them use it. The results showed no significant difference between males and females in knowledge of and use of these MOH tools (Table 7).

58.0% of the study population had noticed the application of the obligatory calorie display policy in restaurants and cafes, and females were significantly more likely to have noticed the application of this policy. After the application of these policies, 25.8% of the participants said that their food choices have changed and 22.5% said that their average spending on food and beverages outside the house has decreased. Females were significantly more likely than males to report these changes. Only 14.9% mentioned that they lost weight after the application of this policy, with no significant difference regarding sex (Table 7).

Table7: Knowledge and use of food related polices and MOH applications in Saudi Arabia

	N	%	Male N	Male %	Female N	Female %	P value
Knowledge of food related polices in Saudi Arabia							
Obligatory calories display	312	52.9	169	57.1	143	48.6	0.04*
KSA free from hydrogenated oils by 2020	122	20.7	72	24.3	50	17.0	0.03*
School canteen free from unhealthy food	201	34.1	84	28.4	117	39.8	0.00*
I don't know	160	27.1	79	26.7	81	27.6	0.81
Not interested	50	8.5	23	7.8	27	9.2	0.54
Know about MOH calories guide							
Yes	219	37.1	116	39.2	103	35.0	0.3
No	371	62.9	180	60.8	191	65.0	
Know about MOH calories calculator							
Yes	178	30.2	89	30.1	89	30.3	0.96
No	412	69.8	207	69.9	205	69.7	
Use MOH calories guide							
Yes	87	14.7	43	14.5	44	15.0	0.99
No	453	76.8	228	77.0	225	76.5	
May be	50	8.5	25	8.4	25	8.5	
Use MOH calories calculator							
Yes	67	11.4	30	10.1	37	12.6	0.28
No	471	79.8	244	82.4	227	77.2	
May be	52	8.8	22	7.4	30	10.2	
Notice obligatory calories display							
Yes	342	58.0	158	53.4	184	62.6	0.07
No	193	32.7	106	35.8	87	29.6	
Not interested	55	9.3	32	10.8	23	7.8	
After application of obligatory calories display							
a. Food choices has changed							
Yes	152	25.8	64	21.6	88	29.9	0.01*
NO	322	54.6	180	60.8	142	48.3	
Some how	116	19.7	52	17.6	64	21.8	

b. Lost weight							
Yes	88	14.9	38	12.8	50	17.0	0.11
NO	403	68.3	214	72.3	189	64.3	
Some how	99	16.8	44	14.9	55	18.7	
c. Spending on ready food has decreased							
Yes	133	22.5	58	19.6	75	25.5	0.00*
NO	367	62.2	207	69.9	160	54.4	
Some how	90	15.3	31	10.5	59	20.1	

Discussion

This study showed that the Saudi population does not follow the dietary guidelines recommendations, especially regarding fruits and vegetables, where the majority (43.5%) did not meet MOH dietary recommendations for any food group. Fruits and vegetables are a major source of vitamins, minerals, and dietary fiber, all of which are important for good health. 32 Even though the number of unhealthy foods eaten in Switzerland is low, the number of unhealthy foods eaten is higher due to higher levels of education, income, eating habits influenced by others, and socioeconomic status

These findings agree with those of previous studies.[1, 33,] and [34] Miller discovered a global insufficiency of fruit and vegetable consumption, particularly in low-income countries, owing to availability and affordability issues.[34]

Al-Rethaiaa and Moradi-Lakeh also reported that only a small percentage of the Saudi population meets the Saudi dietary recommendation, especially when it comes to fruits and vegetables, where 36.1% of Saudi college students rarely eat fruits, while 32.2% said that they rarely eat vegetables.[1,33]

The current study results have found that there is no significant difference in consumption of recommended food groups except for meat and legumes, where males significantly consume more meat than females. These results are constant with Moradi-Lakeh. An explanation of such a difference can be related to masculinity as in meat eating and femininity as in vegetable preference. 1 Furthermore, because of the bloody taste and body discomfort associated with mat eating, females avoid eating meat more than males.[35]

The results of the current study showed a high prevalence of physical inactivity among Saudis where 47.8% of the study population did not perform any PA, especially females, due to limited facilities, time restrictions, inadequate self-efficacy, and absence of social support. Females have limited availability of physical exercise amenities and opportunities and may not have the required information and skills to exercise.[36] Al-Hazzaa and Al-Haqwi agreed with these results, where physical inactivity prevalence in KSA varied from 26% to 85% in males and from 43% to 91% in females.[36,37]

These results reported that the Saudi population does not follow the dietary guidelines, high fat (saturated and trans-fat), carbohydrates, salt, sugar, energy, and caloric consumption lead to poor dietary quality and insufficient nutrients (lack of micronutrients such as vitamins, minerals, and amino acids).[13,16] and an increase in the consumption of UHF does not provide satiety and requires more insulin secretion, which causes more hunger, resulting in eating more food and eventually obesity. It altered glucose and lipid metabolism, associated with insulin resistance, and resulted in aggravated chronic diseases because of moderate levels of undernutrition and high levels of overweight people [30.7%, obesity 28.7%] in increasing the prevalence of NCDs in KSA, e.g., CVDs, diabetes, and metabolic syndromes.16,17 as well as rising NCDS mortality in KSA, and approximately 73% of the underlying causes of death from NCDs (CVDs, diabetes, and cancers).[4,9]

The participants consistently spent more money on unhealthy food (median 95 SR range of 0-2000 SR/week) than healthy food (median 50 SR range of 0-2000 SR/week). This spending pattern is subjected to an increase with an increase in household income.38 Cheaper prices of unhealthy food can be a reason, as 24.2% of the participants reported preferring unhealthy food due to its cheaper prices.[20]

Almost half of the participants (49.7%) think that unhealthy food has a better taste than healthy food. This result agrees with what Mestral and Pinho 1 found, as well as other factors like taste, time, and eating with a friend.[19,20,45] All the above-mentioned details in KSA lead to the high prevalence of diabetes mellitus and hypertension in KSA. In addition to that, NCDs are the main underlying cause of mortality before and during the COVID-19 pandemic.[44,46]

These findings are consistent with other studies (5, 7, 19–24) that people tend to consume large quantities of UHF and not enough HF due to the mass production of processed foods, the impressive marketing of high-fat and high-sugar foods to children, daily habits and limited options, lack of knowledge about healthy eating and about food preparation and how to cook healthy food, busy lifestyles, taste preferences of family and friends, unclear food labeling, lack of willpower, irregular working hours, rapid urbanization, and the changes in lifestyles that lead to changes in food intake patterns. formalized paraphrase Working-family stress is a big problem for most families, and this will eventually lead to UHF use because of lack of time with family, work stress, depression, more responsibilities, anxiety, and irritability.

The correlation between age and healthy practices and spending on healthy food showed that as age increased, the healthy practices score and spending on healthy food increased. In agreement with El-Kassas, they found that senior people attempt healthier practices than juniors.[39]

In this study, 53.1% think that mobile phone applications (MHApps) and 59.2% think that social media networking affects their food choices. Using MHApps and social media, it has become a worldwide phenomenon.[40] This is in agreement with another study in KSA, which reported that the use of MHAs was prevalent in KSA. Using MHApps affects food choices. as The most popular applications were those that recorded daily steps, exercise training, calories, and health consultations. The popularity and ease of use of these applications made people more interested in controlling their diets and lifestyles to maintain good health and the users' perceived benefit.[46]) A systematic review found that there is a significant association between social media use and eating abnormalities.[41] Also, Nelson confirms that social media use has a role in what people eat.[40]

In line with the 2030 vision, mandatory calorie labeling was launched in 2018 in Saudi Arabia.[42] This study found that 52.9% of the participants were familiar with the application of this policy. Females showed significant changes in their food choices and spent more on ready food than males. Weight loss did not show a significant difference as the policy was recently launched and the effect required more time to be visible. Even though these policies didn't change people's choices all that much, even a small decrease in calories is good for their health.

Conclusion
Most Saudis do not comply with the national dietary guidelines' recommendations, are physically inactive, and use mobile phone applications and social media in a way that affects their food choices. Most Saudis are not familiar with the MOH calorie guide and calculator. More than half of Saudis have noticed that calorie labels are now required. They have also changed their food choices and how much they spend on ready-made food, but it will take more time to see how this policy affects their weight.

Strength and limitations
This study had a large and representative sample size, including all the 20 health regions of KSA, including different age groups and social levels, and is considered a broad-spectrum assessment as a baseline of dietary habits. It was conducted in a relatively short time after the application of the obligatory dietary labeling. Limitations, the data collection tool was self-reported, including food consumption behavior, it is subjected to recall and social desirability biases. The study has too many variables, many associations can be made, and we still need to go further into the study.

Recommendations
Saudis' diets need to be studied more often so that dietary trends can be found and the right steps can be taken.

Any effort to promote healthy eating in the Kingdom of Saudi Arabia should focus on increasing the consumption of fruits and vegetables. A coordinated

national effort is needed to alter eating habits. To be used properly, MOH tools and applications need greater promotional activities.

HF Marketing Eating has three components that work together to create a balanced HF system. Policies and laws provide illustrative examples of the function played by the government in consuming and implementing HF procedures. Policymakers have developed numerous schemes to foster a culture of wholesome food. The following are included in the plans

a)   Improving investment plans and policy coherence to accelerate food product reformulation and reduce levels of trans fat, free sugar, and high salt. Implement WHO recommendations as well.

b)   In order to encourage people to demand HF, it is crucial to educate them about the value of HF and healthy living. This can be done by creating school programs that teach students how to read product labels and "point-of-sale" information.

c)   Supporting healthy infant and child feeding routines by encouraging breastfeeding-friendly practices and regulations. Putting into practice the International Code of Marketing Breast-milk Substitutes

Contributions of the Authors
AS and SA conceptualized the study design. AS and LA collected the data. AS analyzed the data and drafted the manuscript. All authors edit and approve the manuscript.

Conflict of Interest
The authors disclosed no potential conflicts of interest and stated that they have no interest.

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List of abbreviations

BMI	Body mass index
CVDs	Cardio Vascular Diseases
F	Frequency
FAO	Food and Agriculture Organization of the United Nations
FF	Fast food
HF	Healthy Food
JF	Junk food
KSA	Kingdom of Saudi Arabia
MHApps	Mobile phone applications
MOE	Ministry of Education
NCDs	Non-communicable diseases
PA	physical activity
r	correlation coefficient
SA	Saudi Arabia
SD	Standard deviation
SFDA	Saudi Food & Drug Authority

SMOH   Saudi Ministry of Health
SPSS   Statistical Package for Social Sciences
SR   Saudi Riyals
WFC   Work-to-family conflict
WHO   World Health Organization
X2   Chi square test

Index 1

Table 8: frequency for eating practices and means of total healthy, and unhealthy practices score

Practice	Never		1-2 times /month		Once a week		2-4 times/ week		5 times or more/week		Mean	std
	N	%	N	%	N	%	N	%	N	%		
a) Healthy eating practices												
Eating breakfast	41	6.9	7	1.2	82	13.9	228	38.6	232	39.3	3.024	1.0946
Fixed meal time	152	25.8	11	1.9	91	15.4	211	35.8	125	21.2	2.247	1.4821
Having meal with family at home	33	5.6	10	1.7	95	16.1	264	44.7	188	31.9	2.956	1.0250
Plate similar to the healthy plate	168	28.5	16	2.7	195	33.1	139	23.6	72	12.2	1.883	1.3709
Eating three meals/day	72	12.2	7	1.2	91	15.4	239	40.5	181	30.7	2.763	1.2462
b) Unhealthy eating practices												
Eating late dinner	55	9.3	15	2.5	137	23.2	237	40.2	146	24.7	2.685	1.1503
Ready food consumption	33	5.6	19	3.2	162	27.5	204	34.6	172	29.2	2.785	1.0742
Fast food consumption	53	9.0	28	4.7	200	33.9	173	29.3	136	23.1	2.527	1.1604
Sweets consumption	48	8.1	21	3.6	156	26.4	211	35.8	149	25.3	2.647	1.1601
Soft drinks consumption	143	24.2	31	5.3	131	22.2	114	19.3	171	29.0	2.236	1.5241
Energy drinks consumption	377	63.9	13	2.2	76	12.9	73	12.4	51	8.6	.997	1.4297

Index   II

The translated questionnaire

Healthy eating and its determinants among Saudi adults assessment Questionnaire

Do you agree to participate?
□ yes   □ no
Section One (Personal and Demographic Information)
Gender: □ male   □ female
Place of living
Region ....
□ In a city
□ outside a city
Age ………………
Educational Qualification
□ read and write / primary
□ Intermediate
□ secondary
□ University and above
Field of specialization, study or work
□ In health sector or medicine
□ In educational sector
□ Outside health or education sectors
Marital status
□ single
□ married
□ divorced
□ widow
Monthly income
□ enough
□ Not enough
□ enough and redundant

What is your assessment of your health?
□ excellent
□ very good
□ good
□ weak
Work
□ Not working (housewife - student - trainee)
□ working
□ retired
Do you have a chronic disease?
□ Yes   □ No   □ Not sure
If the answer is yes, specify the diseases you suffer from:
□ high blood sugar

□ high blood pressure
□ heart disease
□ Gastrointestinal Diseases
□ Obesity or overweight
□ High blood lipids
□ Other
□ I don't know
smoking
□ smoker
□ non-smoker
□ ex-smoker

Section Two (healthy food eating)

How many servings of meat and legumes do you eat per day?
(One serving equals 60-90g of red meat, chicken or fish or ½ cup of cooked legumes)
□ Never eat it   □ Less than 2 servings
□ 2-3 servings   □ More than 3 servings
How many servings of milk and its derivatives you eat per day?
(The serving is equal to a cup of milk or yogurt - 240 ml - or 30 g of cheese)
□ Never eat it   □ Less than 2 servings
□ 2- 4 servings   □ More than 4 servings
How many servings of fruits do you eat per day?
(The serving is equal to a medium apple, orange or banana or half a cup, 120 ml - juice or half a cup of dried fruits)
□ Never eat it   □ Less than 2 servings
□ 2- 4 servings   □ More than 4 servings
How many servings of vegetables do you eat per day?
(The serving is equal to a cup of vegetables or half a cup of juice or half a cup of cooked vegetables)
□ Never eat it   □ Less than 3 servings
□ 3-5 servings   □ More than 5 servings
How many servings of cereal and bread do you eat per day?
(One serving equals 25gm of bread - or ½ cup of cooked cereal or breakfast cereal, or 4-6 medium crackers)
□ Never eat it   □ Less than 6 servings
□ 6-11 servings □ More than 11 servings

How many cups of water do you drink daily?
(a cup is 240 ml)
□ Never drink it   □ Less than 6 cups   □ 6 cups
□ More than 6 cups
Do you do physical activity?
□ Yes, I do physical activity every day
□ I do physical activity but not daily
□ I never do physical activity
Do you do physical activity?
□ I do not do any physical activity except for daily activities
□ An idle life (less than five thousand steps a day)
□ Low (less than two and a half hours per week or 5,000 to less than 7,500 steps per day)
□ Medium (two and a half to less than five hours per week) or (7,500 to ten thousand steps per day)
□ High (more than five hours per week) or more than 10,000 steps per day

Section III (Determinants of healthy food eating)

How many times a week:

Do you eat 3 meals (breakfast - lunch - dinner) in one day?
□ I don't eat it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month
Do you eat breakfast?
□ I don't eat it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month
You eat your meals almost at fixed times every day?
□ I don't eat it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month
Do you eat meals with some or all family members at home?
□ I don't eat it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month

Does your plate resemble a healthy plate (25% grains – 25% protein – 30% vegetables – 20% fruits)?
□ I don't eat it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month
Do you eat dinner late (less than two hours before bed)?
□ I don't eat it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month
Do you eat ready-made meals in a restaurant or outside the home?
□ I don't eat it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month
Do you eat fast food as (burger - French fries - fried chicken - shawarma - pizza)?
□ I don't eat it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month

Do you eat sweets and sugars such as (chocolate, cookies, cake, basbousa, konafa, donut, ice cream)?
□ I don't eat it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month
Drink soft drinks like (Pepsi, 7Up, Barbican)?
□ I don't drink it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month
Drink energy drinks like (Red Bull, Bison, Code Red)?
□ I don't drink it
□ Once a week
□ 2-4 times a week
□ 5 or more times a week
□ 1-2 times a month

How do you see your salt consumption if you know that the recommended amount of salt does not exceed 5 grams (1 teas poon) Daily?
□ I use less than the recommended amount per day
□ I use what is within the recommended amount per day
□ I use more than the recommended amount per day
□ I don't know
□ I don't care

What type of fat do you usually use in your food?
□ butter
□ ghee
□ vegetable oils
□ hydrogenated oils
□ I don't know
□ not interested

What is your average weekly expenditure in Saudi riyals on fast food? ....
What is your average weekly expenditure in Saudi riyals on healthy meals? ....
What kind of food do you prefer?
□ healthy food   □ unhealthy food   □ both
If you prefer to eat healthy food, what are the reasons for your preference?
□ To maintain my weight
□ I have a chronic disease
□ Participant in a diet program
□ other
□ Lifestyle (I was raised on these habits)
If you prefer to eat unhealthy food, what are the reasons for your preference?
□ Taste better
□ cheaper
□ quick to prepare
□ Long working hours
□ Work environment is not suitable (no refrigerator - microwave - heater)
□ I don't know how to cook
□ Eating with friends
□ other

Section 5

(Knowledge and use of food-related policies and Ministry of Health applications)

Do you know any of these food policies?
□ Mandatory application of calories labelling in all restaurants and cafes
□ Saudi Arabia is free from factories that use hydrogenated oils By 2020
□ School canteens shall be free of unhealthy food and drinks
□ I don't know
Do you know the existence of the Ministry of Health Calorie Guide?
□ yes   □ no
Do you know about Ministry of Health calories calculation app?
□ yes   □ no
Have you used or viewed Ministry of Health Calorie Guide?
□ yes   □ no
Have you used or viewed Ministry of Health calories calculation app?
□ yes   □ no
Have you noticed the application of obligatory calorie labeling of foods on restaurant menus?
□ Yes   □ No   □ Not sure
Did your meal choices affected by the calorie labeling of foods on menus?
□ Yes   □ Somewhat   □ No
Have you lost weight?
□ Yes   □ Somewhat   □ No
Has your average spending on food and drinks outside the home decreased?
□ Yes   □ Somewhat   □ No